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(54) Name of Invention: Loudspeaker

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[*Translator's note: Japanese names can be read in many different ways. Commonly used readings were selected for the above names.]

Description

1. **Name of Invention:**

   Loudspeaker

2. Extent of Patent Claims

(1) A multiple number of vibrators are arranged on a same plane and they are divided into multiple sets of rings. A modulation signal modulated from a carrier high frequency signal with a speech sound signal is applied to the vibrators. Directivity is adjusted by properly adjusting the phase delay angle of the phase delay devices. This loudspeaker is characterized by having this directivity adjustment means.

3. Detailed Explanation of Invention

[Industrial application area]

This invention is concerned with a loudspeaker that has adjustable directivity.

[Conventional technology]

Diagram 7 and 8 indicate a portable loudspeaker (a portable megaphone) using a trumpet speaker. The unit integrates microphone 12, amplifier 13 which amplifies speech sound signals output from microphone 12, trumpet speaker 15 with phone 15a, which is driven by the signal amplified by amplifier 13, battery 17, which supply power to amplifier 13, through power switch 16. Speech sound signals that are collected at microphone 12 are amplified and produce loud speech sound signals through trumpet speaker 15 and the sound volume of the generated speech sound from trumpet speaker 15 can be adjusted with sound volume adjuster 14. 14 in the diagram is the sound volume adjuster.

[Problems that this invention tries to solve]

However, the above conventional example needed large phone 15a to prevent the hauling and to make the speech sound reach far in distance with an adequate directivity with a trumpet speaker with phone 15a. As a result, it has the problem of a unit size being large. Also, it had a problem when trying to carry information to a specifically limited area far in distance because the directivity of phone 15a is designed to carry information to a relatively near and wide area and is fixed. If, however, a parametric speaker with sharp directivity is used as a loudspeaker, then it is not suited to carry information to people relatively near and widespread.

This invention was made in consideration of the above points. The purpose is to provide a small-size loudspeaker that has adjustable directivity depending on the purpose and application to carry information, and can be used for all purposes.

[Means to solve the problems]

A multiple number of vibrators are arranged on the same plane and they are divided into multiple sets of rings. A modulation signal modulated from a carrier high frequency signal with a speech sound signal is applied to the vibrators. Directivity is adjusted by properly adjusting the phase delay angle of the phase delay devices.

[Functions]

This invention is structured as above. A multiple number of vibrators are arranged on the same plane and they are divided into multiple sets of rings. A modulation signal applied to each vibrator is modulated from a carrier high frequency signal with a speech sound signal and directivity is adjusted by properly adjusting the phase delay angle of the phase delay devices. It provides a small-size loudspeaker that has adjustable directivity depending on the purpose and application to carry information, and can be used for all purposes.

[Actual example]

Diagram 1 through 4 indicate an example of this invention. A multiple number of vibrators 1_1, 1_2, 1_3, 1_4 are arranged on the same plane (installed on board 11) and are divided into multiple sets of rings (four sets in this example). A modulation signal f_m modulated from carrier high frequency signal $f_{e?}$ with a speech sound signal f_s is applied to the vibrators through phase delay devices 5_1, 5_2, 5_3, 5_4. Directivity is adjusted by properly adjusting phase delay angle θ_1, θ_2, θ_3, θ_4 of the above phase delay devices 5_1, 5_2, 5_3, 5_4. In this example the directivity adjustment is achieved with directivity adjustment volume 6 and delay angle circuits 7_1, 7_2, 7_3, 7_4 to set phase delay angles.

Carrier high frequency signal $f_{e?}$ generated by oscillator 2 is modulated with the amplified speech sound signal f_s which was amplified by amplifier 4 and output from

microphone 12. Furthermore, the driving signals that were properly delayed by phase delay devices 5_1, 5_2, 5_3, 5_4 are amplified by amplifiers 8_1, 8_2, 8_3, 8_4, and then applied to vibrators 1_1, 1_2, 1_3, 1_4. The degree of amplification of amplifiers 8_1, 8_2, 8_3, 8_4 is set by sound volume adjuster 9 and amplification setting circuits 10_1, 10_2, 10_3, 10_4. In this example, four sets of vibrators 1_1, 1_2, 1_3, 1_4 were used. However, n sets of vibrators 1_1, 1_2, ...1_n can be used.

The action of this example is explained as follows: Diagram 5 shows the action principle of a parametric speaker using the nonlinear interaction of sound waves in the air. Two sound waves with slightly different frequencies $f_1$and f_2 are emitted as indicated in Diagram 5. These two frequencies $f_1$and f_2 interact in the air (using the nonlinear property of air) and a sum frequency and a difference frequency, $f_1+ f_2$ and $f_1- f_2$, are produced as indicated in Diagram 5 (b). At this action, if two frequencies f_1 and f_2 are set to be ultrasonic, and difference frequency $f_1- f_2$ is set to be audible, the audible sound generated in the air would have a sharp directivity and can be sent to a specific area.

In the actual example, vibrators 1_1, 1_2, 1_3, 1_4 are driven by modulation wave f_m modulating carrier high frequency signal f_e, with speech sound signal (audible sound signal) f_s. Modulation wave f_m , as indicated in Diagram 5, has both an upper sideband and lower sideband. Two ultrasonic waves ($f_1$and f_2) are generated by these upper and a lower sidebands and emitted in the air. As a result, an audible sound of a difference frequency $f_1- f_2$ corresponding to the original speech sound signal f_s is regenerated by the non-linear interaction of two ultrasonic in the air.

In the actual example, adjusting directional volume adjuster 6 located at the back of loudspeaker X, the area where audible sound is regenerated can be set narrow (sharp directivity) to send the information in a far and specific area or set relatively wide (wide directivity) to send information in a near and wide area. Therefore, all purpose loudspeaker X is provided to change the directivity of speech sound signals depending on the purpose and application. Also, loudspeaker X is small and has

sharp directivity without using a large phone as was the case with phone 15a in the conventional example.

[Effects of the invention]

This invention is structured as above. A multiple number of vibrators are arranged on the same plane and they are divided into multiple sets of rings. A modulation signal applied to each vibrator is modulated from a carrier high frequency signal with a speech sound signal and directivity is adjusted by properly adjusting the phase delay angle of the phase delay devices. It provides a small-size loudspeaker that has adjustable directivity depending on the purpose and application to carry information, and can be used for all purposes.

4. Brief description of the Diagrams

Diagram 1: Frontal view of the core section of the actual example of this invention.

Diagram 2: Side view of the same.

Diagram 3: Block circuit of the same.

Diagram 4 (a): Cross section of the same.

Diagram 4 (b): Frontal view of the same.

Diagram 4 (c): Back view of the same.

Diagram 5 and 6: Supporting diagram to explain the actions of the same.

Diagram 7 (a): Cross section of a conventional example.

Diagram 7 (b): Frontal view of the same.

Diagram 7 (c): Back view of the same.

Diagram 8: Block circuit of the same.

1_1, 1_2, 1_3, 1_4 are vibrators. 2 is an oscillator. 3 is a modulator. 4 is an amplifier. 5_1, 5_2, 5_3, 5_4 are phase delay devices. 6 is a directivity volume adjuster.

Attorney, Choshichi Ishida

可聴音が再生されるエリアを狭く（指向性を鋭く）設定して遠くの特定のエリアに情報を伝えるようにしたり、第6図(b)に示すように、可聴音が再生されるエリアを比較的広く（指向性を広く）設定して近くの広いエリアに情報を伝えるようにすることができる。したがって、目的、用途に応じて指向性を変化させることができ、汎用性のある拡声器Xを提供できるようになっている。また、従来例のように大型のホーン15aを用いることなく鋭い指向性を実現しているので、小型の拡声器Xを実現できることになる。

【発明の効果】

本発明は上述のように構成されており、同一平面に配設された多数の振動子を同状に複数組に分割し、各組の振動子に印加される超音高周波を音声信号で変調した変調信号の位相遅延角を適宜調整することにより、指向性を調整する指向性調整手段を設けたものであり、目的、用途に応じて指向性を変化させて情報を伝達することができ、汎用性があり、しかも小型の拡声器を提供できるという効果がある。

4．図面の簡単な説明

第1図は本発明一実施例の要部正面図、第2図は同上の要部側面図、第3図は同上のブロック回路図、第4図(a)は同上の側面図、第4図(b)は同上の正面図、第4図(c)は同上の背面図、第5図および第6図は同上の動作説明図、第7図(a)は従来例の側面図、第7図(b)は同上の正面図、第7図(c)は同上の背面図、第8図は同上のブロック回路図である。

1₁，1₂，1₃，1₄は振動子、2は発振器、3は変調器、4は増幅器、5₁，5₂，5₃，5₄は位相遅延器、6は指向性調整ボリュームである。

代理人　弁理士　石　田　長　七

Diagram 1
第1図

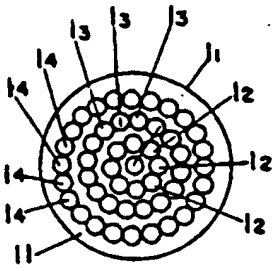


Diagram 2
第2図

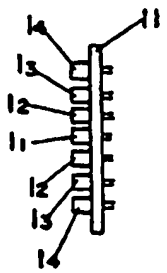


Diagram 4
第4図

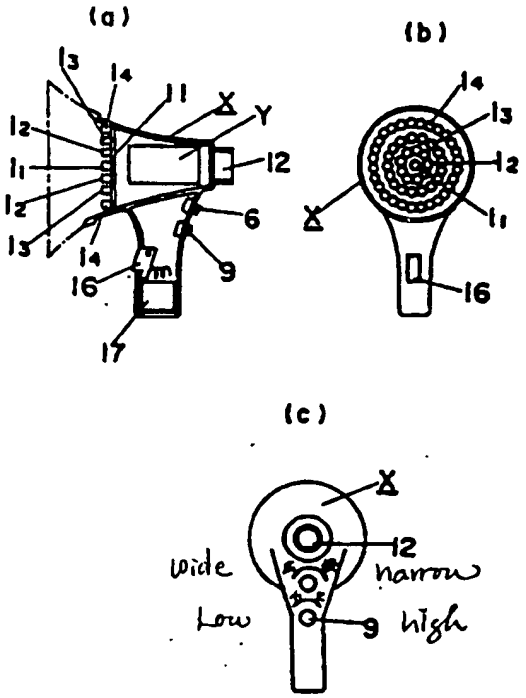


Diagram 3
第3図

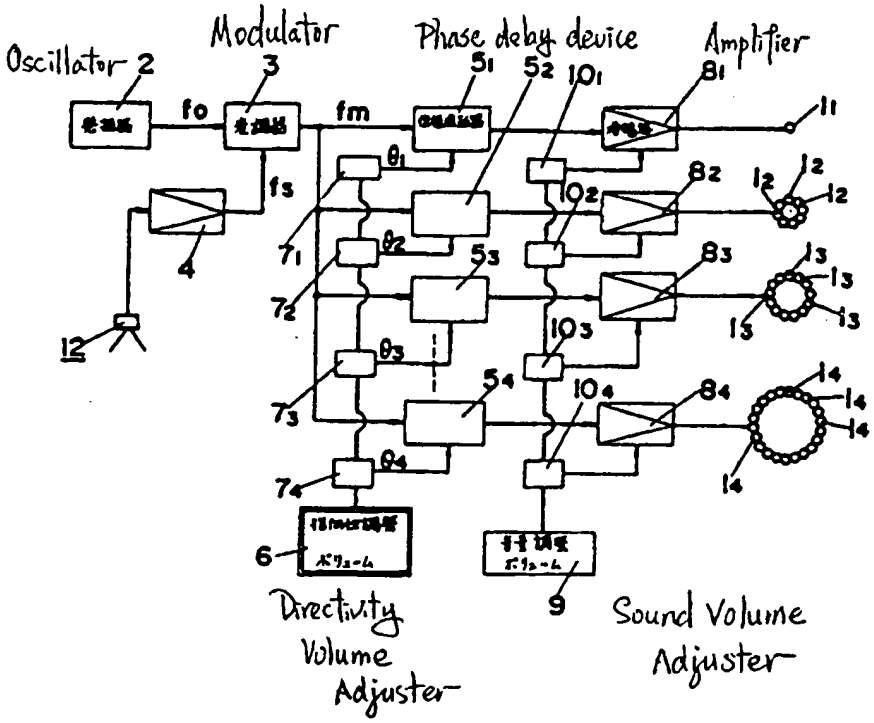
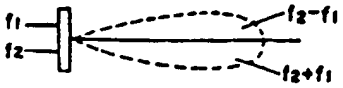
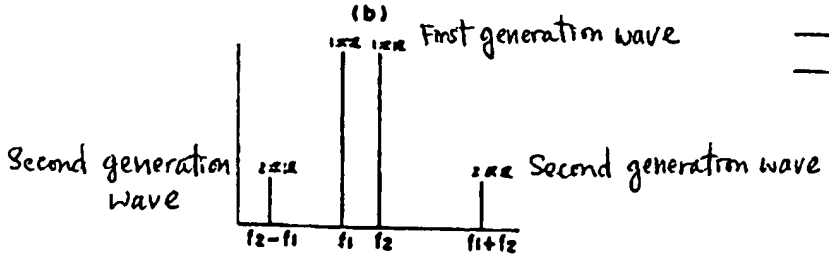


Diagram 5
第5図





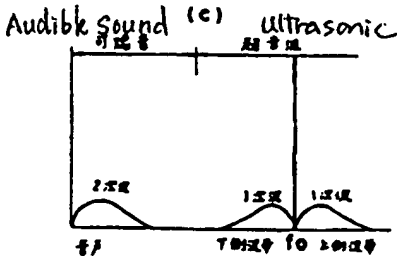
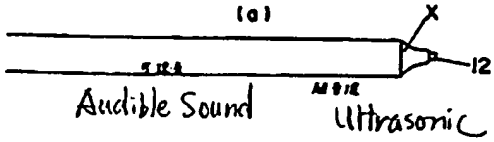


Diagram 6
第6図



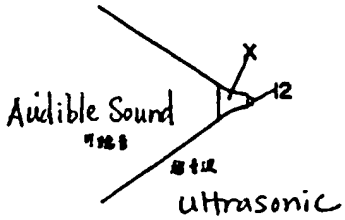
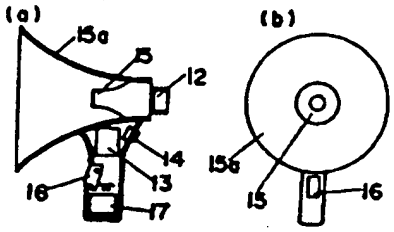


Diagram 7

第7図



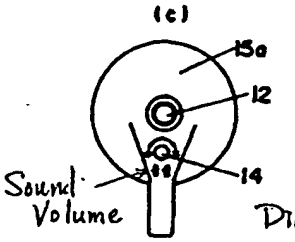


Diagram 8

第8図